The Global Challenge of Hidden Hunger: Perspectives from the Field

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The global challenge of hidden hunger: perspectives from the field

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The aim of this review paper is to explore the strategies employed to tackle micronutrient deficiencies with illustrations from field-based experience. Hidden hunger is the presence of multiple micronutrient deficiencies (particularly iron, zinc, iodine and vitamin A), which can occur without a deficit in energy intake as a result of consuming an energy-dense, but nutrient-poor diet. It is estimated that it affects more than two billion people worldwide, particularly in low- and middle-income countries where there is a reliance on low-cost food staples and where the diversity of the diet is limited. Finding a way to improve the nutritional quality of diets for the poorest people is central to meeting the UN sustainable development goals particularly sustainable development goal 2: end hunger, achieve food security and improved nutrition and promote sustainable agriculture. As we pass the midpoint of the UN's Decade for Action on Nutrition, it is timely to reflect on progress towards achieving sustainable development goal 2 and the strategies to reduce hidden hunger. Many low- and middle-income countries are falling behind national nutrition targets, and this has been exacerbated by the COVID-19 pandemic as well as other recent shocks to the global food system which have disproportionately impacted the world's most vulnerable communities. Addressing inequalities within the food system must be central to developing a sustainable, cost-effective strategy for improving food quality that delivers benefit to the seldom heard and marginalised communities.

Micronutrient intake: Sustainable development goals: Biofortification: Dietary supplementation

Introduction

The year 2020 marked the mid-point of the UN's Decade for Action on Nutrition (2016–2025)[1], however, the total number of people living with severe food insecurity has continued to rise since 2015[2]. Achieving zero hunger by 2030 is one of the seventeen sustainable development goals and now is a time when there is an intensified spotlight on global nutrition research, with the UN Food Systems Summit and Nutrition for Growth Summit both taking place in 2021. Over the past decade, a series of landmark publications in the Lancet[3–8] have provided a sharp focus on the previously unprecedented level of detail on the scale of the challenges the international nutrition research community faces to reduce malnutrition in all its forms, frequently referred to as the 'triple burden of malnutrition' that encompasses overnutrition, undernutrition and micronutrient deficiencies.

The presence of multiple micronutrient deficiencies in the absence of an energy-deficit diet is often described as 'hidden hunger'[9]. Iron, zinc, iodine and vitamin A

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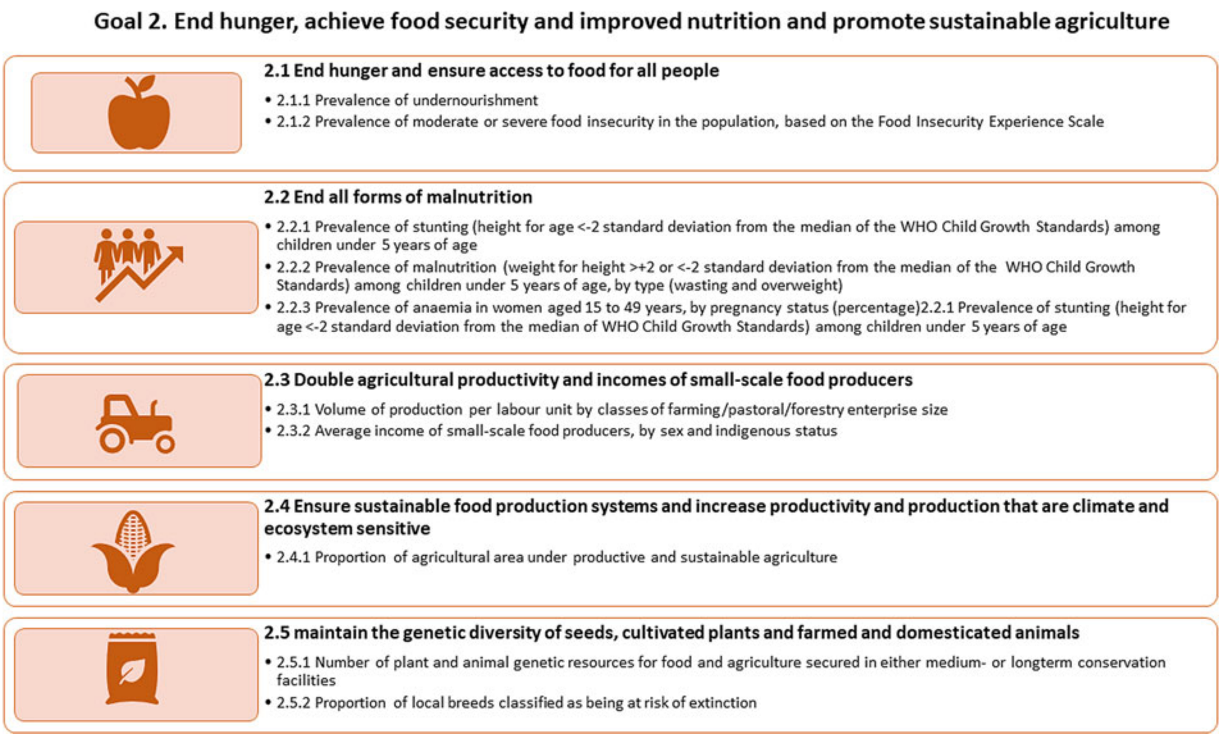

Fig. 1. UN sustainable development goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture. Adapted from[12].

are the most frequently limiting micronutrients in the diet, which often occur as a result of consuming an energy-dense, but nutrient-poor diet[10]. It is estimated that hidden hunger affects over two billion people worldwide[11], particularly in low- and middle-income countries where there is a reliance on low-cost staples and where the diet is monotonous, and choices are limited by poverty. A successful strategy to tackle hidden hunger needs to be sustainable, cost-effective and able to deliver benefit in the most remote and marginalised communities. For the longer term, a 'systems approach' is needed that encompasses all elements of the food value chain, to ensure a secure and sustainable food supply that is resistant to global shocks.

The aim of this paper, arising from a presentation by the author at the Nutrition Society Winter Meeting of 2020, is to explore the strategies employed to address hidden hunger, illustrated with examples from research in this field.

Are we on track to achieve sustainable development goal 2: zero hunger?

UN sustainable development goal 2 is to 'end hunger, achieve food security and improved nutrition and promote sustainable agriculture'. Within this goal, a number of internationally agreed targets have been identified, to be achieved by 2030[12]. These are summarised in Fig. 1.

Within this framework of targets, specific indicators have been identified to enable individual countries to track their progress, such as a reduction in the prevalence of stunting and malnutrition (Fig. 1).

On a global scale, there has been some progress against these indicators, with the proportion of children under 5 years of age suffering from chronic undernutrition decreasing from 23·1 % in 2015 to 21·3 % in 2019. However, although the prevalence of stunting has also decreased in recent years, 144 million children under 5 years of age were still affected by this in 2019, three-quarters of whom lived in Central and Southern Asia or sub-Saharan Africa. The 2020 Global Nutrition Report reveals that the total number of people living with severe food insecurity has continued to rise since 2015[13]. An estimated 26·4 % of the world population, about 2 billion persons, were affected by moderate or severe food insecurity in 2018, an increase from 23·2 % in 2014[2]. In terms of overnutrition, in 2019, childhood overweight affected 38 million children under 5 years of age worldwide (WHO 2020) and is rising most rapidly in low- and middle-income countries, particularly in urban settings. In 2019, almost half of the children under 5 who were overweight or obese lived in Asia[14]. Despite progress being made against undernutrition, the UN is clear that the world is not on track to achieve zero hunger by 2030[15].

Strategies to improve nutrient density of diet

Historically, the drive to increase food production to meet the needs of the growing global population has focused on maximising yield and efficiency. Whilst energy production has increased however, diets have become less micronutrient rich. Where household income is limited, the priority is to purchase low-cost, energy-dense food such as staples of wheat, rice and potatoes, leading to a reduction in dietary diversity and low micronutrient intakes[3]. Various strategies have been employed to improve micronutrient intake including supplementation, fortification, biofortification and diet diversification. Each of these types of interventions can deliver benefit, but all have limitations depending on the context and resources available to maximise their reach and impact.

Supplementation

Supplementation offers a direct solution to micronutrient deficiencies in targeted contexts where they can be diagnosed and managed effectively. Systematic reviews of the literature provide robust evidence of the effectiveness of supplementation programmes for improving micronutrient status, for example, iron[16]. Provision of iron and folate supplements to women of childbearing age has done much to improve anaemia and pregnancy outcome globally[17]. For zinc, the evidence for the impact of supplementation on improving zinc status is more difficult to demonstrate due to the lack of a sensitive biomarker of zinc status[18,19] and the presence of multiple micronutrient deficiencies which frequently occur together[20]. Nevertheless, there is evidence that zinc supplementation in infancy and early childhood increases specific growth outcomes[21], particularly after 2 years of age[22]. However, identifying those most at risk of zinc deficiency for a targeted supplementation strategy is difficult due to the lack of a reliable diagnostic tool, without which it is also difficult to monitor the impact of zinc intervention programmes[23]. On a population level, supplementation to address hidden hunger is not practical because it is expensive, reliant on the ability to reach those most at risk, and dependent on the compliance of the population. For the individual, supplementation can provide a short-term solution but does not solve the longer-term problem of a nutrient-poor diet.

Food fortification

Food fortification includes both the addition of micronutrients to foods during processing and to food immediately prior to consumption (e.g. multiple micronutrient powders). One of the most successful global fortification strategies has been the addition of iodine to salt. Iodine deficiency has profound health consequences, linked to the crucial role of iodine in thyroid hormone synthesis manifested as impaired growth and cognitive development[24]. The fortification of salt with iodine is mandatory in many countries, with UNICEF reporting a household uptake of 86 % globally[25]. The success of a national fortification strategy is contingent on effective distribution and affordability of the fortified product such that all communities have access. Health literacy in the target communities is also important for people to make informed choices. In addition, carefully controlled production and monitoring of the fortified product is required for quality assurance and safety with at least regional, if not national, level coordination and investment. In a study to explore the knowledge, attitudes and practice regarding the consumption of iodised salt in a rural community in Pakistan, we found that there was a lack of awareness regarding the health benefits of iodine. Iodised salt was available in the local market; however, the price was a few rupees higher than the non-iodised salt and this presented a significant barrier to its purchase. Further investigation also revealed that the locally available iodised salt production was not subject to any coordinated quality control scheme, and the level of iodine in the 'fortified' salt fell markedly below the dose range required for health benefits, highlighting a weakness in the fortification strategy to reach marginalised communities[26]. Food fortification thus tends to favour urban areas where there is greater infrastructure for the distribution of fortified products than in rural regions, and where there are often communities with greater socioeconomic status, coupled with higher levels of health literacy.

Increasing dietary diversity

Dietary diversity is a measure of the range of foods belonging to different food groups, consumed by an individual over a defined time period. The greater the diversity of a diet, the lower the risk that the diet is insufficient in terms of micronutrient supply, thus understanding dietary patterns is an important tool in designing the strategic approach to combat hidden hunger. Questionnaire-based methods have been developed to assess diet diversity at the population level. These have an advantage over other methods of assessing nutrient intake in that they provide a simplified means of gathering information that does not rely on detailed, labour-intensive diet analyses and highly skilled enumerators. Foods are organised by food group (e.g. pulses, nuts and seeds, dairy, dark green leafy vegetables) and through exploration with the respondent, the frequency of consumption of foods within each of the food groups is used to derive a diversity score[27]. The minimum diet diversity for women is a validated population-level proxy of micronutrient adequacy from the diet in non-pregnant women of reproductive age[28]. It can be measured using either open recall or a list-based method resulting in a score from 1 to 10 according to the number of food groups consumed in a 24 h period from ten defined food groups. The indicator is dichotomous, with the threshold for achieving minimum dietary diversity set at a score of ≥ 5. A comparison of the recall and a list-based method against a weighed food intake record revealed that both methods are likely to over-report the number of women achieving the minimum score[29]. In a study of dietary diversity in a resource-poor setting in Pakistan, we reported that MMD-W was not achieved by most of the participants. This low diet diversity was associated with a high prevalence of zinc deficiency (measured using plasma zinc concentration), however, surprisingly, iron deficiency was not detected using established biomarkers (blood Hb and serum ferritin concentrations)[30]. This may have been due to the intake of iron from non-food sources, such as iron leached from the cooking pots. These studies highlight the need for caution when interpreting dietary diversity data and a need

Table 1. Examples of biofortified crops, the enriched nutrient and the country where the crop has been trialled

Biofortified crop	Target micronutrient	Country where crop has been trialled
Orange sweet potato[31,32]	Vitamin A	Uganda; Zambia
Beans [33–35]	Iron	Uganda; Zimbabwe; Rwanda
Cassava[36,37]	Vitamin A	Nigeria; Democratic Republic of Congo; Kenya
Maize[38]	Vitamin A	Nigeria; Democratic Republic of Congo; Zambia; Zimbabwe
Pearl millet[33,39,40]	Iron	India
Wheat[41–44]	Zinc	India; Pakistan
Rice[45]	Zinc	Bangladesh

to have an in-depth knowledge of the local cooking practices and presence of locally available fortified food products, such as vitamin A-fortified cooking oil, that may also be overlooked when using dietary diversity assessment tools.

Biofortification

Biofortification is the enhancement of the micronutrient content of a food either through crop breeding programmes or agronomic methods (e.g. addition of nutrient-rich fertilizer) or a combination of both. Examples of biofortified staple crops that have been released in Africa and South Asia are provided in Table 1.

Biofortification is an appealing solution where other interventions fail. It offers a complementary and affordable method to improve micronutrient intake and status of a population's vulnerable groups. Once the biofortified plant has been developed, the seed can be distributed widely, and reproduced year on year by the farmers. After the initial cost of the breeding programme, the ongoing costs are minimal, although support may be necessary to optimise fertilizer application to realise the micronutrient content potential of the crop. It also requires little, if any, behaviour modification because, in most cases, biofortification has little effect on the crops' sensory characteristics, thus increasing its acceptability and sustainability as a micronutrient intervention. For the successful scale-up of a biofortification programme, several key factors are required as illustrated in Fig. 2.

Robust evidence for improvements in nutritional status of target population can be gathered from efficacy trials, where the impact of the consumption of the biofortified food on biomarkers of nutrient status and health outcomes can be monitored through carefully controlled feeding studies under experimental conditions. Such studies have demonstrated that consuming zinc-biofortified wheat starch can increase total zinc absorption by 30–70 % [41,46]. Efficacy trials may thus provide proof of concept; however, effectiveness trials are necessary to demonstrate acceptability, impact and scalability in real-world situations. We are conducting a programme of research, known as BiZiFED, to evaluate the potential

What is required for successful scale-up of a biofortified crop?

✓ Robust evidence for improvements in nutritional status of target population
- efficacy studies
- effectiveness trials

✓ Evidence of acceptability of biofortified crop to
- producers
- consumers

✓ Engagement and Advocacy
- with decision makers and policy makers
- with consumers

Fig. 2. Key factors for the successful scale-up of a biofortification programme.

for a HarvestPlus produced zinc-biofortified wheat variety, Zincol-2016, to improve zinc status in women of reproductive age and adolescent girls and infants in Pakistan[42,47]. In the first phase of this programme, a study was conducted to explore the performance of Zincol-2016 under different soil conditions and fertilizer regimens. This study revealed that, while there was no yield advantage for the biofortified zinc wheat variety (Zincol-2016), it was competitive with the currently grown wheat varieties[44]. Our preliminary analyses indicate that under optimal conditions, i.e. including foliar application of zinc-rich fertilizer, the zinc content of Zincol-2016 may achieve levels of up to 45 mg/kg compared with a notional standard whole-grain zinc concentration of 25 mg/kg. Based on an average starch consumption of 250 g per capita daily, this could potentially contribute up to 11 mg Zn daily, compared with 6·25 mg from the standard wheat variety, contributing significantly to the estimated average requirement of 10·3 mg/d[48]. Whilst more information is needed regarding the bioavailability of the zinc from the grain, initial studies indicate that the phytate content (main inhibitor of zinc absorption) of the Zincol-2016 grain is equivalent to that of standard varieties. The current phase of the research programme involves a double-blind cluster randomised trial of 500 households who are receiving either starch milled from Zincol-2016 wheat grain grown by local farmers, or a control non-biofortified variety (Galaxy), for a period of 6 months[42]. The cluster randomised trial is currently underway and the outcome measures include biomarkers of zinc status, anthropometry, and incidence and duration of diarrhoea and upper respiratory tract infections in adolescent girls and infants. For successful scale-up, the views of all stakeholders must be considered; therefore, the study also includes a

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detailed evaluation of the performance of the crop in different locations across Punjab province, under different agronomic conditions. A survey of over 500 farmers and a series of focus group discussions with both male and female community members have been conducted to explore the barriers and enablers to the potential national scale-up of Zincol-2016. In addition, formative research was conducted immediately prior to the current cluster randomised trial to explore the acceptability of Zincol-2016 to local farmers and consumers[49]. This revealed that the acceptability of Zincol-2016 to farmers and consumers was good, but there was some suspicion from the community who believed that the biofortified starch may reduce fertility. Affordability was also highlighted as a potential barrier to purchase although they felt this could be overlooked if the benefits to health were demonstrated.

Conclusions

In order to achieve maximum impact towards addressing hidden hunger, all four of the strategies described earlier for increasing micronutrient intake should be harnessed using a coordinated approach. This requires joined-up knowledge of regional and national interventions and initiatives to maximise efficiency and programme coverage. However, the answer to achieving sustainable development goal 2 globally lies in viewing the entire food value chain through a 'systems approach'. The food system is a complex interactive network involving interactions between food producers, processors, distributors and consumers. During the current COVID-19 pandemic, we have become acutely aware of the fragility of the food system to shocks that disrupt food production and distribution. Closure of international borders has impacted the labour force, particularly seasonal migrant workers involved in planting and harvesting crops. Restricted movement due to imposed lockdowns has also impacted on the transport of crops to market[2] and access of consumers to market, particularly in settings where open markets are the primary food outlets. Food loss and waste has been an inevitable consequence of the pandemic with crops unable to be harvested or transported to the market being left to rot in the field and milk being poured away due to interrupted supply chains[50]. However, the pandemic is not the only current threat to the system. Climate change, conflict and population increases also add pressure to the global supply of nutritious food. The climate crisis continues to impact food production globally, with changes in weather patterns, drought and flooding having direct effects on crop yields. In addition, 2020 saw a locust swarm devasted wheat crops in parts of South Asia and sub-Saharan Africa, leading to food insecurity, particularly in the most disadvantaged communities. Reducing inequalities must be central to building better, more resilient food systems for the future, as highlighted by the Global Nutrition Report 2020[13]. Solving the global challenge of hidden hunger can only be achieved through coherent action at all levels of the system, driven and supported by national and international policy.

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Conflict of Interest

None.

Authorship

The author had sole responsibility for all aspects of preparation of this paper.

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